Population Estimates of Tuktoyaktuk Peninsula, Cape Bathurst and Bluenose-West Barren-ground Caribou Herds using Post-calving Photography, July 2009

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Abstract

A post-calving photographic survey was conducted in 2009 to obtain population estimates for the Tuktoyaktuk Peninsula, Cape Bathurst, and Bluenose-West caribou herds in the NWT. Eighty-three collars were deployed March 2009 in anticipation of the survey. Photos were taken of the Tuktoyaktuk Peninsula herd on 13 July, Cape Bathurst herd on 13 and 18 July and Bluenose-West herd on 12-13 July. The resulting population estimates (±95% CI) were 2,753±276 for the Tuktoyaktuk Peninsula herd, 1,934±350 for the Cape Bathurst herd and 17,897±1,310 for the Bluenose-West herd.

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Introduction

The first photo-surveys of barren-ground caribou post-calving aggregations within the range of the Cape Bathurst and Bluenose-West herds were accomplished in 1986 and 1987 by McLean and Russell (1992). From the mid-1960s until 1999 barren-ground caribou east of the Mackenzie River to Kugluktuk (Coppermine), and south from the Arctic Coast to Great Bear Lake were managed as the Bluenose herd (McLean and Russell 1992, Nagy et al. 1999). Results of telemetry surveys which incorporated data from a satellite tracking program indicated that there were three distinct herds using three calving grounds (Nagy et al. 1999, Nagy 2009 In prep.; Zittlau et al. 2003) in the historical Bluenose range. From west to east, these herds are now referred to as the Cape Bathurst, Bluenose-West and Bluenose-East herds. Seasonal ranges for the three herds were determined using satellite data of collared cows from March 1996 to May 2004 (Nagy et al. 2005). Nagy (2009 In prep.) re-analyzed caribou surveys from 1986, 1987, 1992 and 2000 using the identified ranges of the three herds.

The Tuktoyaktuk Peninsula herd was first identified to the Department of Environment and Natural Resources (ENR) during community consultations (ENR 2005). It was first surveyed in September 2005 (ENR 2005) and the first photo survey was conducted in July 2006 (Nagy and Johnson 2006). It is currently being managed as a separate herd by the Wildlife Management Advisory Council (NWT) (WMAC) and ENR. The proportion of the herd that is reindeer or caribou-reindeer hybrids is unknown. Community members in Tuktoyaktuk believe that caribou returned to the peninsula after

the domesticated reindeer herd was removed from Tuktoyaktuk Peninsula in 2001 (Nasogaluak, personal communication).

Post-calving photo survey results in 2005 and 2006 showed a significant decline in the Cape-Bathurst and Bluenose-West herds since they were surveyed in 2000 (Nagy and Johnson 2006). Management actions were taken by the WMAC (NWT) and the Gwich'in and Sahtu Renewable Resources Boards. These co-management boards also recommended that ENR conduct a post-calving photo-survey of these herds in 2009. This report presents the results of the photo-survey of the Tuktoyaktuk Peninsula, Cape Bathurst and Bluenose-West herds during July 2009.

Methods

Reconnaissance and Collar Deployment

In March 2009, reconnaissance flights were flown to determine the late winter distribution of barren-ground caribou in order to facilitate appropriate distribution of collar deployment throughout the herds. Flight lines were planned based on historical seasonal range (Nagy et al. 2005), current collared caribou locations, and in the Inuvik region [Inuvialuit Settlement Region (ISR) and Gwich'in Settlement Area (GSA)] a concurrent muskoxen survey (results reported separately).

Flights were conducted using Helio Courier and Cessna 206 fixed-wing aircraft (North-Wright Airways Ltd. Norman Wells, NWT). All locations of observed caribou were recorded using a handheld Garmin GPS. Due to the requirements for the muskoxen survey in the Inuvik region (ISR and GSA), flight lines were flown at an average survey altitude of 110 m above ground level (agl) and average speed of 165 km/h. In the Sahtu Settlement Area (SSA), flights were flown at an average survey altitude of 110 m AGL and average speed of 200 km/h. Flight lines were spaced 5 km apart in the Inuvik region and approximately 20 km apart in the SSA (Figure 1). The number of caribou observed and general composition of the group (cow/calves, bulls, mixed) was provided with location co-ordinates to the capture crew.

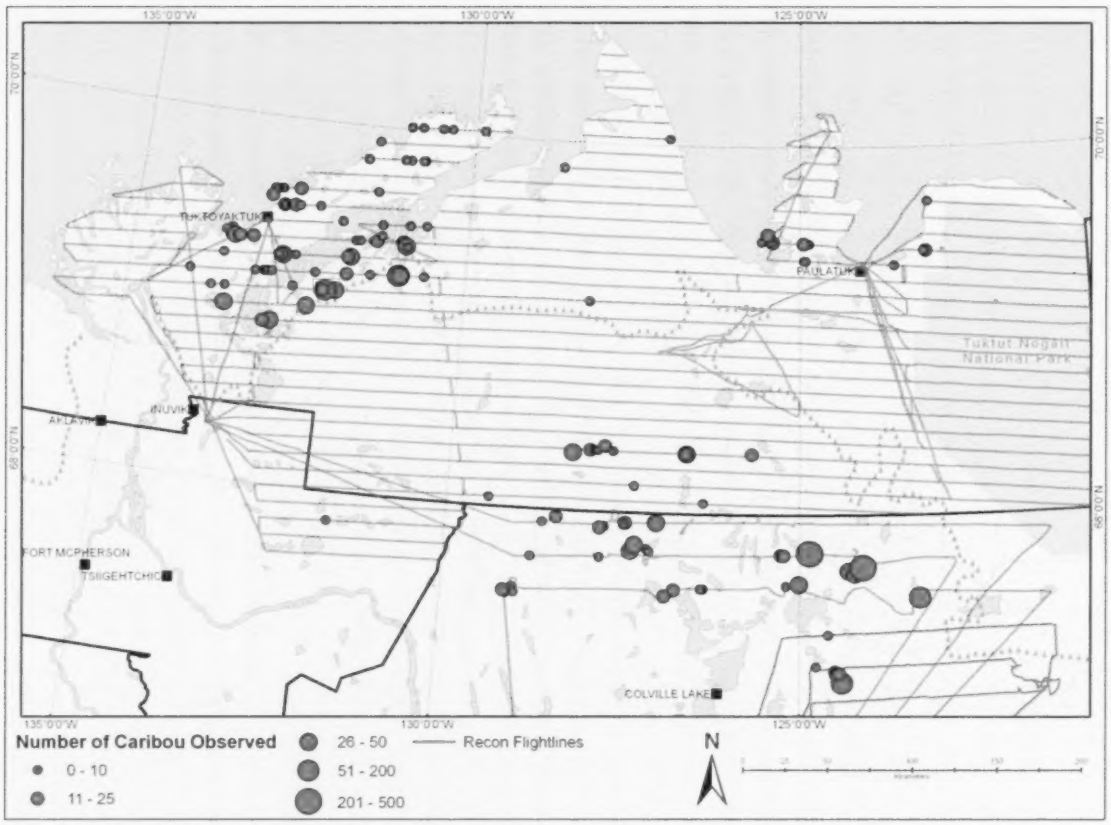

Figure 1: Reconnaissance flight lines and observation locations of barren-ground caribou groups, March 2009.

Captures were planned based on caribou locations obtained from the reconnaissance flights to ensure collars were deployed throughout the occupied range. Capture crews consisted of a helicopter pilot, a net-gunner and an animal handler. Captures were conducted using an A-Star helicopter (Great Slave Helicopter Inuvik, NWT) with a sliding door on the same side as the pilot for net gunning.

Captures were conducted using operating procedures as approved by the NWT Wildlife Care Committee (WCC). Captures could only be conducted between temperatures of -5°C to -30°C with a pursuit times of less than two minutes. The caribou

were captured with a net and immobilized with leg hobbles. Eye covers were used to help calm the animals. Each animal was initially examined to assess its condition and to check for any capture-related injuries. Samples collected from each animal included: approximately 30 mL of blood (from the femoral vein in the foreleg), approximately 50 g of feces (either from the ground after defecation, or the rectum), and a sample of hair (with roots). Both eyes were checked for besnoitiosis, and body measurements were taken (total body length, hind foot length, and neck circumference).

Satellite (SAT) and Global Positioning Satellite (GPS) collars were placed on the animals. The SAT collars were manufactured by Telonics (Telonics, Inc., Mesa, AZ) and the GPS collars were manufactured either by Telonics or Lotek (Lotek Wireless Inc., Newmarket, Ontario). All GPS collars were programmed to obtain locations every eight hours (three locations a day). SAT collars were programmed to transmit daily locations between 25 May and 15 July, 2005 and locations every five or seven days during the rest of the year. Collars were also equipped with a VHF transmitter programmed to transmit for 16 hrs/day started at 1500 UTC (9 a.m. local time) over the calving and post calving periods. Each collar was equipped with an automatic release (Telonics CR-2A) set to drop off 1 August, 2012. All cow caribou were fitted with collars in a similar fashion; the collar being snug around the neck but allowing for an open-palmed hand to be moved freely between the neck and the collar material. As the necks of bull caribou expand during the rut, collars were affixed loosely on bulls; more space than a clenched fist was available between the neck and the collar material.

We considered collar number recommendations made by Rettie (2008 *In prep.*) and used targets of 60 collars for the Bluenose-West, 25 for the Cape Bathurst and 25 for the Tuktoyaktuk Peninsula herds.

Post-calving survey

Flights were flown in early July based on GPS/SAT collar locations. All GPS and SAT collars deployed between 2006 and 2009 were located to ensure that the VHF was functioning. All collars with a malfunctioning GPS/SAT component were scanned to determine if the VHF component was functioning. Located collars with verified VHF functioning were compiled into a list for the post-calving photo survey. VHF collars that were deployed before 2007 but still transmitting were not used for the calculations because extensive flight to locate VHF collars outside of the post-calving range was not conducted.

The herds were monitored remotely using locations from GPS and SAT collars and periodic flights. Once weather and flying conditions were favorable, and caribou formed large aggregations, collared caribou were located and high quality digital photos taken. Photos were taken from the fixed-wing aircraft using a Nikon D200 or Nikon D3x digital camera. The photographer was seated behind the pilot in the Helio Courier and the window was removed to take photographs. In the Cessna 206 the photographer sat in the co-pilot seat and opened the window to take photographs. The collar frequencies, photo frame numbers and GPS waypoints were recorded and each aggregation was assigned a group number. The cameras were connected to the GPS using a Nikon MC-35 GPS Adapter Cord so a latitude and longitude were also recorded with the photographs. If the aggregation could not be captured in one photo, a series of

overlapping photos were taken in one pass to ensure minimal movement of caribou between frames.

The best photo for each group was selected. Digital photos were loaded into OziExplorer GPS Mapping Software (Version 3.95.4m, D & L Software Pty Ltd.) to create a photomap of each image. For large caribou groups covered by more than one photo, overlapping images were loaded side-by side on two computer screens and track lines in OziExplorer were created to delineate overlapping areas on images. All adult caribou were counted on the photographs. All of the Tuktoyaktuk Peninsula and Cape Bathurst photos along with 28 of the 34 Bluenose-West photos (of 30 groups – some groups had multiple photos) were counted again, independently by another counter, to test for counting error.

The percent of counted animals that were a result of incidental observations were calculated by dividing the number of caribou associated with a group that had no radio-collared caribou by the total number of caribou counted and multiplying by 100.

Population estimate and trend

Population estimate was calculated using the equation:

$$N = \left(\frac{(M+1)(C+1)}{(R+1)}\right) - 1$$

where N=estimate of population size during the survey; M=total number of caribou with active radio collars present in the herd; C=number of caribou in all aggregations observed during the survey; R=number of radio-collared caribou observed in these aggregations during the survey.

The 95% confidence interval (CI) for the estimate can then be calculated as 95% CI=1.96 $Var(N)^{0.5}$, where:

$$Var(N) = \frac{\big((M+1)(C+1)(M-R)(C-R)\big)}{(R+1)^2(R+2)}$$

A Lincoln-Petersen estimator of relative abundance (K) was used for each herd to determine if the population estimates of caribou in 2006 and 2009 were significantly different (Williams et al. 2002). It was assumed that capture probabilities were different between 2006 and 2009. K and variance of K [$Var(K)$] was estimated for each herd as follows (Williams et al. 2002):

$$K = \frac{\left[\left(\frac{(M_b+1)(C_b+1)}{(R_b+1)}\right)-1\right]}{\frac{M_aC_a}{R_a}}$$

$$Var(K) = \left(\frac{R_aM_bC_b}{R_b^3M_a^3C_a^3}\right)\big[\big((C_b-R_b)(M_b-R_b)(R_aM_aC_a)\big) + \big((C_a-R_a)(M_a-R_a)(R_bM_b \quad _b)\big)\big]$$

where the same inputs (M,C and R) are used as for the population estimation equation (N). The $_a$ and $_b$ refer to data from the time period 2006 and 2009 of the comparisons, respectively.

The 95% CI of K was calculated as 1.96 $Var(K)^{0.5}$ (Williams et al. 2002). If K was <1 and the 95% CI did not include 1, the population estimate for 2009 was significantly lower than that for 2006. If K was >1 and the 95% CI did not include 1, the population estimate for 2009 was significantly higher than that for 2006. If the 95% CI around K included 1, the population estimates for 2006 and 2009 were not significantly different.

There are four assumptions related to this method of population estimate (Russell et al. 1996):

Assumption 1: The population is closed.

Assumption 2: All highly aggregated groups contain at least one radio-collared caribou and can be located.

Assumption 3: Radio collared animals are randomly distributed throughout the herd.

Assumption 4: No significant movement of individual caribou among photographed groups used in the estimate occurred during the photo survey.

Post-calving photo surveys likely underestimate herd size (Rivest et al. 1998); however, this method is consistent with historic surveys (Nagy and Johnson 2006) and indicates population trend.

Weather Conditions

The post-calving survey method relies on the caribou forming aggregations in response to insect harassment (Rivest et al. 1998). Weather conditions that are associated with increased insect harassment and caribou aggregation are warmer days with calmer winds (Dau 1986, Walsh et al. 1992, Hagemoen and Reimers 2002). Weather data presented, including air temperature in Celsius and wind speed in km/hr, were obtained from the community aerodrome radio station (CARS) weather station at Tuktoyaktuk, and the Parks Canada weather station in Tuktut Nogait National Park.

Results

Reconnaissance and Collar Deployment

Reconnaissance flights flown in March and the distribution of observed caribou are plotted in Figure 1. Flights were conducted in the ISR between March 9th and 20th and in the SSA, between 16 and 19 March. Weather conditions, that were generally sunny with calm winds and cold temperatures (average -38°C), were suitable for aerial observation of wildlife.

Between 9 and 31 March, 83 caribou were captured by aerial net gunning (Figure 2) and equipped with a collar (39 Telonics GPS, 39 Telonics SAT and 5 Lotek GPS). No survey flights or captures were conducted within 50 km of the community of Colville Lake due to concerns of the community.

Average pursuit time for caribou capture was one minute. Average handling time, from when the caribou was in the net to release, was 16 minutes.

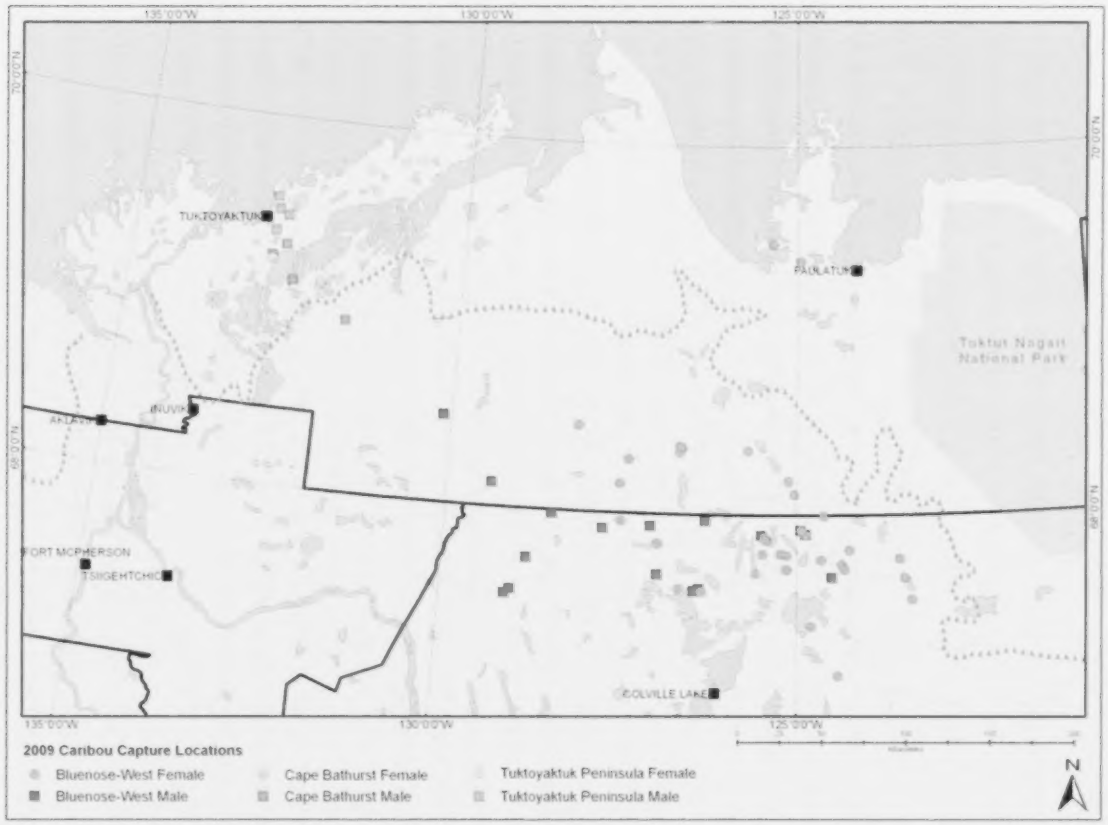

Figure 2: Capture locations of barren-ground caribou, March 2009.

Post-calving survey

Surveys beginning 30 June verified which collars with VHF components were working. There were 27 collars available in the Tuktoyaktuk Peninsula herd, 28 collars in the Cape Bathurst herd, and 54 collars in the Bluenose-West herd (Table 1). Of the 83 collars deployed in March 2009, five collars were stationary or had been harvested before July (three collars on Tuktoyaktuk Peninsula and two collars from Bluenose-West). Seven of the Bluenose-West herd satellite collars malfunctioned and were not located. One collar, deployed on the Bluenose-East winter range and located on the

Bluenose-East calving ground previously was photographed in a group with a Bluenose-West collar.

Table 1: Sex, number and capture year of active caribou collars during the post-calving photo survey of the Tuktoyaktuk Peninsula, Cape Bathurst and Bluenose-West herds, July 2009.

	Female					Male			Grand Total
Year Collared	**2006**	**2007**	**2008**	**2009**	**Female Total**	**2008**	**2009**	**Male Total**	
Cape Bathurst	6	4	4	6	20	6	2	8	28
Tuktoyaktuk Peninsula	2	0	4	14	20	0	7	7	27
Bluenose-West	3	4	5	28	40	0	14	14	54

Photos were taken of the Tuktoyaktuk Peninsula herd on 13 July, Cape Bathurst herd on 13 and 18 July; and Bluenose-West herd on 12 and 13 July.

Tuktoyaktuk Peninsula had the highest percentage of incidental sightings with 16.3% of the counted caribou not associated with collars. The percentages of caribou counted that were not associated with a collar for the Cape Bathurst and Bluenose-West herds were 7.2% and 8.9%, respectively.

There was a 2.5% difference between the independent count of photographs with no counting bias either high or low by either counter evident. Of the 30 groups of Bluenose-West caribou that were counted by photo (groups less than ten were not counted by photo), 25 were independently recounted. Of the ten groups of Cape Bathurst caribou that were counted by photo, nine were independently recounted. For the 15 Tuktoyaktuk Peninsula groups counted by photograph, 11 were independently

recounted. For each photo counted twice, an average of the two counts was used for calculations.

Population estimate and trend: Tuktoyaktuk Peninsula

There were 27 collars available on the Tuktoyaktuk herd and 25 of those collared caribou were photographed (Figure 3). The total number of adult caribou counted on the photographs was 2,556 (Table 2). The population is estimated to be 2,753±276 (95% CI).

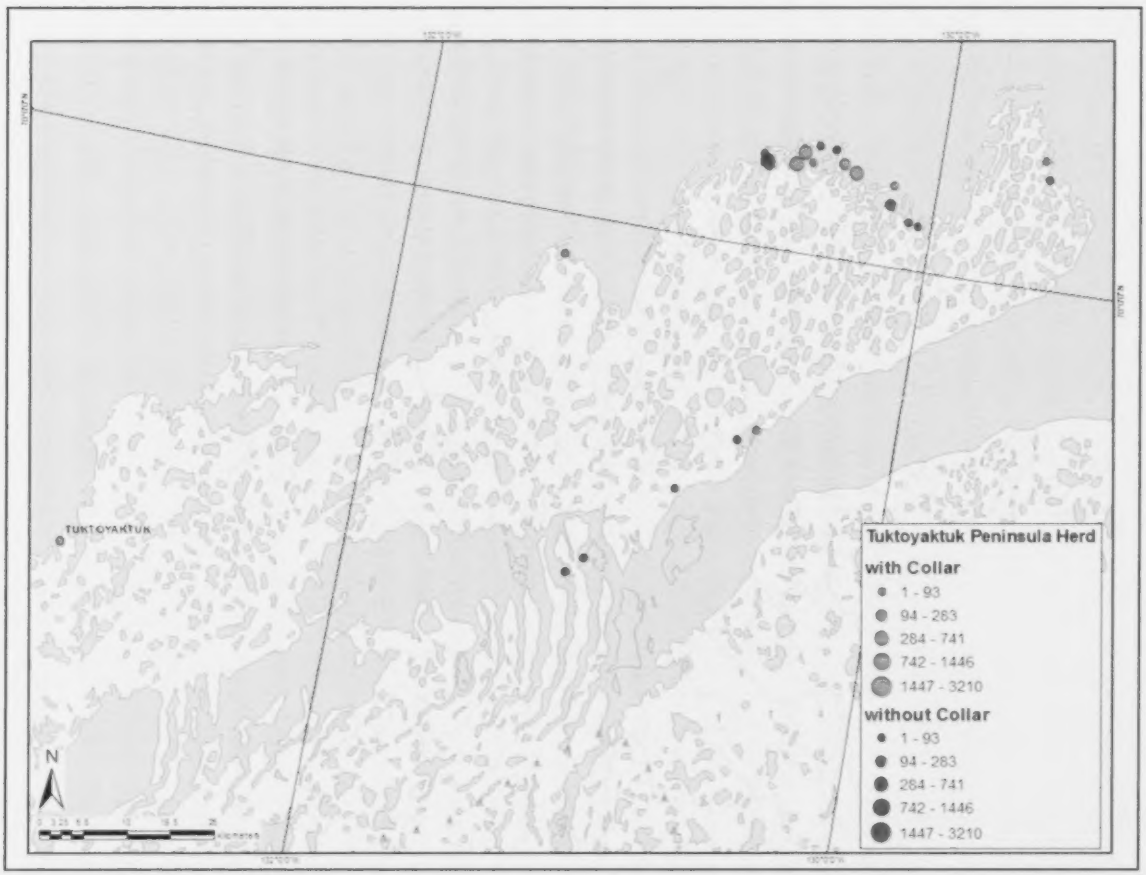

Figure 3: Locations of caribou groups observed 13 July on Tuktoyaktuk Peninsula herd's post-calving range.

Table 2: Non-calf caribou counted on Tuktoyaktuk herd photographs, 13 July, 2009.

Date	Group	#Collars	Number of caribou
13-Jul-09	1	0	1
13-Jul-09	2	0	2
13-Jul-09	3	0	2
13-Jul-09	4	0	2
13-Jul-09	5	1	4
13-Jul-09	6	0	42
13-Jul-09	7	1	44
13-Jul-09	8	0	6
13-Jul-09	9	0	7
13-Jul-09	10	0	109
13-Jul-09	11	1	35
13-Jul-09	12	8	372
13-Jul-09	13	2	169
13-Jul-09	14	2	85
13-Jul-09	15	0	12
13-Jul-09	16	0	8
13-Jul-09	17	4	357
13-Jul-09	18	3	633
13-Jul-09	19	2	397
13-Jul-09	20	0	150
13-Jul-09	21	0	47
13-Jul-09	22	0	30
13-Jul-09	23	1	42
Total		25	2,556

The 2009 population estimate was compared to the 2006 results (Table 3) from Nagy and Johnson (2006), which estimated the population at 3,078 (no CI). *K* was calculated to be 0.89 with a 95% CI of 0.095. Therefore, the 2009 population estimate is significantly lower than the 2006 estimate.

Table 3: Population estimates for the Tuktoyaktuk Peninsula herd, 2006 to 2009.

Year	M	C	R	*N*	*95% CI*	Lower 95%CI	Upper 95%CI	CV (%)
2006	27	3,078	27	*3,078*	--	--	--	--
2009	27	2,556	25	*2,752*	*276*	2,476	3,028	10.0

Population estimate and trend: Cape Bathurst

There were 28 collars available on the Cape Bathurst herd and 22 of those collared caribou were photographed (Figure 4). The total number of adult caribou counted on the photographs was 1,534 (Table 4). The population is therefore estimated to be 1,934±350 (95% Confidence Interval).

Table 4: Non-Calf Caribou Counted on Cape Bathurst herd Photographs, 13 and 18 July, 2009.

Date	Group	#Collars	Number of caribou
13-Jul-09	1	1	1
13-Jul-09	2	1	14
13-Jul-09	3	1	2
13-Jul-09	4	1	1
18-Jul-09	5	0	4
18-Jul-09	6	1	59
18-Jul-09	7	0	66

Date	Group	#Collars	Number of caribou
18-Jul-09	8	5	511
18-Jul-09	9	5	282
18-Jul-09	10	4	267
18-Jul-09	11	1	15
18-Jul-09	12	1	127
18-Jul-09	13	1	144
18-Jul-09	14	0	41
Total		22	1,534

The 2009 population estimate was compared to the 2006 results (Table 5) from Nagy and Johnson (2006), which estimated the population at 1,821±149. K was calculated to be 1.06 with a 95% confidence interval of 0.225. Therefore, the population estimates for 2009 and 2006 are not significantly different.

Table 5: Population Estimates for the Cape Bathurst Herd, 1986-2009.

Year	M	C	R	*N*	*95% CI*[1]	Lower 95%CI	Upper 95%CI	CV (%)
2000	17	9,857	15	*11,089*	*1,756*	9,333	12,845	15.8
2005	32	2,213	29	*2,434*	*257*	2,178	2,691	10.5
2006	33	1,714	31	*1,821*	*149*	1,672	1,971	8.2
2009	28	1,534	22	*1,934*	*350*	1,584	2,284	18.1

Population estimate and trend: Bluenose-West

There were 54 collars available on the Bluenose-West Herd and 50 of those collared caribou were photographed (Figure 4). The total number of adult caribou counted on the photographs was 16,595. The population is therefore estimated to be 17,897±1,310 (95% CI).

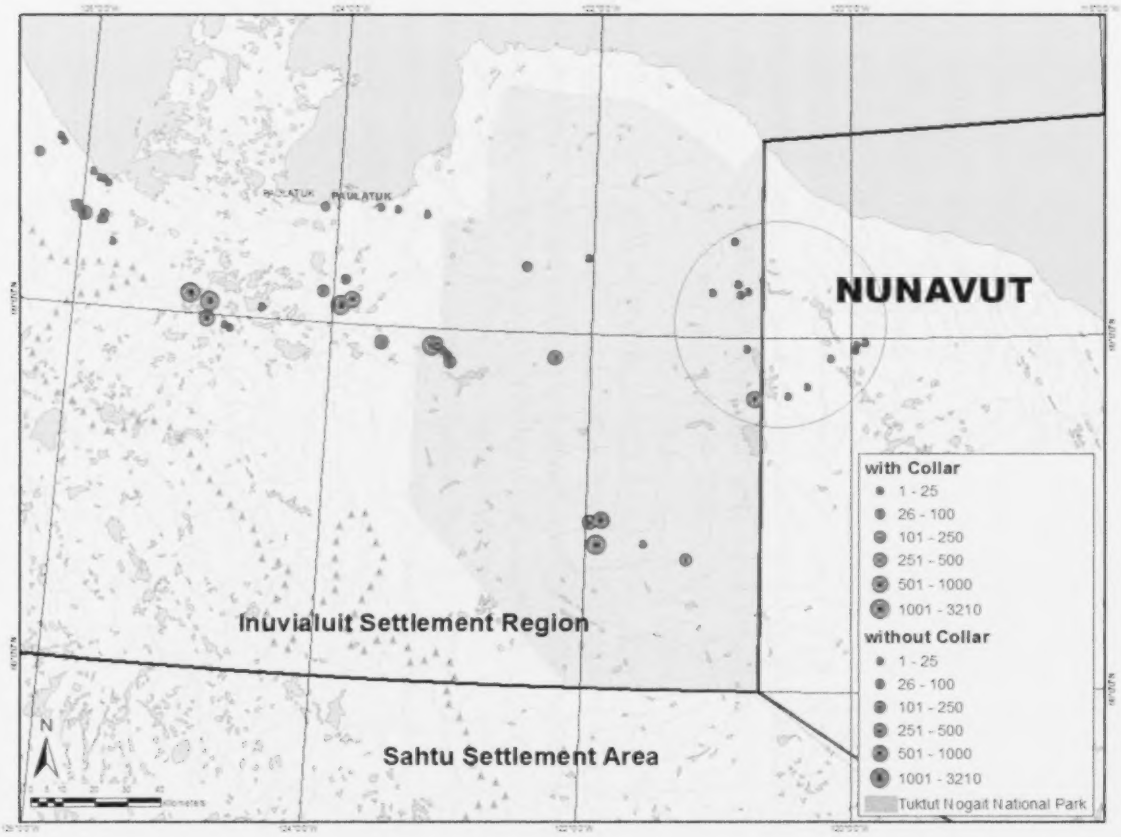

Figure 4: Locations of caribou groups observed on Bluenose-West herd's post-calving range. Area circled is where photographs were taken 13 July, rest of photographs were taken 12 July.

Bluenose-West group 42 (Table 6) had a Bluenose-East collared caribou along with the Bluenose-West collared caribou. Therefore, the number of caribou were split 50-50 so only half the group was considered Bluenose-West in the analysis.

Table 6: Non-calf caribou counted on Bluenose-West herd photographs 12-13 July, 2009.

Date	Group	#Collars	Number
12-Jul-09	1	2	950
12-Jul-09	3	1	25
12-Jul-09	6	0	3
12-Jul-09	9	0	25
12-Jul-09	12	0	13
12-Jul-09	13	0	4
12-Jul-09	14	0	84
12-Jul-09	15	0	5
12-Jul-09	16	1	486
12-Jul-09	17	1	258
12-Jul-09	18	1	51
12-Jul-09	19	1	24
12-Jul-09	20	0	6
12-Jul-09	21	0	1
12-Jul-09	22	0	3
12-Jul-09	23	0	1
12-Jul-09	24	0	5
12-Jul-09	25	10	3,210
12-Jul-09	26	3	1,162
12-Jul-09	27	3	195
12-Jul-09	28	4	1,446
12-Jul-09	29	2	287
12-Jul-09	30	0	70
12-Jul-09	31	1	741
12-Jul-09	32	12	2,539
12-Jul-09	33	0	163
12-Jul-09	34	0	1
12-Jul-09	35	1	254
12-Jul-09	36	1	62
12-Jul-09	37	1	166
12-Jul-09	38	0	1

Date	Group	#Collars	Number
12-Jul-09	40	1	363
12-Jul-09	41	0	599
12-Jul-09	42	1	2,515
12-Jul-09	43	0	19
12-Jul-09	44	1	190
12-Jul-09	52	0	6
12-Jul-09	53	0	1
12-Jul-09	54	0	3
12-Jul-09	55	0	1
12-Jul-09	56	0	1
12-Jul-09	57	0	3
13-Jul-09	58	0	1
13-Jul-09	59	0	1
13-Jul-09	60	0	7
13-Jul-09	61	0	1
13-Jul-09	63	0	14
13-Jul-09	64	1	1
13-Jul-09	65	0	6
13-Jul-09	66	0	20
13-Jul-09	67	0	1
13-Jul-09	68	0	3
13-Jul-09	69	1	183
13-Jul-09	70	0	415
Total		50	16,595

The 2009 results were compared to the 2006 results (Table 7) from Nagy and Johnson (2006), which estimated the population at 18,050±257. *K* was calculated to be 0.99 with a 95% CI of 0.08. Therefore, the population estimate for 2009 and 2006 are not significantly different.

Table 7: Population estimates for the Bluenose-West herd, 1986 to 2009.

Year	M	C	R	*N*	*95% CI*	Lower 95%CI	Upper 95%CI	CV (%)
2000	47	52,508	32	*76,376*	*14,347*	62,029	90,723	18.8
2005	63	17,875	54	*20,800*	*2,040*	18,760	22,840	9.8
2006	66	17,781	65	*18,050*	*527*	17,523	18,578	2.9
2009	54	16,595	50	*17,897*	*1,310*	16,587	19,207	7.3

N = estimate of population size during the census
M = number of radio collared caribou present in the herd (including all collars known to be active during the survey)
C = number of caribou in all aggregations observed during the survey
R = number of radio collared caribou observed in these aggregations during the survey

Weather Conditions

Weather conditions were cool in early July, 2009. Temperature and wind conditions reported for Tuktoyaktuk and Tuktut Nogait National Park on survey dates of 12, 13, and 18 July were generally warmer and calmer than other days between 1-22 July that year. Detailed weather data for Tuktoyaktuk and Tuktut Nogait National Park during July 2009 is presented in Tables 8 and 9.

Table 8: Weather at Tuktoyaktuk CARS station, July 2009.

	10:00			15:00			19:00		
Date	Temp. (°C)	Wind Direction	Wind Speed (km/h)	Temp. (°C)	Wind Direction	Wind Speed (km/h)	Temp. (°C)	Wind Direction	Wind Speed (km/h)
1-Jul-09	9.9	80	17	13	50	19	10	40	19
2-Jul-09	5.7	20	17	5.5	30	19	6.8	40	19
3-Jul-09	4.1	30	17	3.6	360	19	4.1	360	19
4-Jul-09	4.7	340	7	6.9	330	17	7.1	10	15
5-Jul-09	8.1	290	19	7.9	300	22	7.2	320	15
6-Jul-09	5.6	300	7	10.7	350	9	9.7	350	9
7-Jul-09	5.8	320	19	3.5	360	19	2.2	20	19
8-Jul-09	1.9	270	6	6	20	4	8.7	70	7
9-Jul-09	10.4	80	9	13.5	40	17	8.7	20	20
10-Jul-09	4.3	310	22	5.8	300	24	6.3	310	28
11-Jul-09	5.5	320	15	4.8	350	17	4.7	350	13
12-Jul-09	10.9	0	0	12.6	10	7	13.4	60	7
13-Jul-09	15	140	9	16.3	50	19	12.1	50	17
14-Jul-09	3.6	30	17	2.8	20	22	3.1	350	30
15-Jul-09	6	20	24	5.2	10	37	5	360	28
16-Jul-09	3.9	310	22	5.2	330	19	4.8	300	17
17-Jul-09	2	320	4	6.2	10	6	10	360	9
18-Jul-09	11	60	19	12.5	40	17	11.4	50	17
19-Jul-09	4.9	40	11	6	360	26	5.7	30	20
20-Jul-09	5	100	11	11	60	15	8.6	50	24
21-Jul-09	4.4	60	20	5.8	10	26	6.6	50	17
22-Jul-09	4.2	30	13	8.5	60	17	8.6	50	20

*Grey highlighted dates are dates photographed.

Table 9: Weather at Tuktut Nogait National Park weather station, July 2009.

	10:00			15:00			19:00		
Date	Temp. (°C)	Wind Direction	Wind Speed (km/h)	Temp (°C)	Wind Direction	Wind Speed (km/h)	Temp. (°C)	Wind Direction	Wind Speed (km/h)
1-Jul-09	22.2	8	6	16.5	2	19	14.1	11	7
2-Jul-09	16.4	6	19	15.4	5	24	12.5	4	20
3-Jul-09	12.4	26	13	13.5	1	17	9.2	2	13
4-Jul-09	5.5	1	15	7.2	1	24	3.1	34	20
5-Jul-09	3.6	29	26	3.6	31	22	5.9	30	26
6-Jul-09	6.2	28	28	9.5	30	30	8.2	32	33
7-Jul-09	4.2	29	26	2.2	32	17	-1	1	20
8-Jul-09	-2.4	33	24	0.1	31	19	0.6	29	19
9-Jul-09	6.1	30	22	5.9	32	26	6.5	32	20
10-Jul-09	-1.4	28	26	-0.5	31	35	-0.5	33	32
11-Jul-09[2]				2.2	33	15	0.7	36	13
12-Jul-09	10.2	25	17	9.7	29	17	8.3	35	17
13-Jul-09	10.5	9	7	14.8	4	6	11	30	13
14-Jul-09	4.9	24	6	2.5	4	6	2	2	15
15-Jul-09	2.7	11	46	4.1	14	19	1.8	29	9
16-Jul-09	8.1	7	19	6.3	2	24	5.2	34	17
17-Jul-09	3.9	27	19	6.2	26	22	5.4	28	22
18-Jul-09	10.4	27	9	12.1	30	11	13.3	1	7
19-Jul-09	20.2	25	19	11.7	27	20	6	3	9
20-Jul-09	4.2	33	4	5.8	34	9	7.3	35	7
21-Jul-09	15.1	28	11	9	35	11	10	1	11
22-Jul-09	19.3	26	13	12.1	2	15	11.2	2	11

*Grey highlighted dates are dates photographed.
[1]Data unavailable at 10:00.
[2]Data unavailable from Environment Canada.

Discussion

Evaluation of Number of Collars Available

Rettie (2008 *In prep.*) used 2006 herd data in simulations to determine the number of collars required to have more than 80% probability of detecting at least 90% of each herd, including 6.4% of observed caribou detected incidentally. These collar numbers were: 81 Bluenose-West, 35 Cape Bathurst and 21 Tuktoyaktuk Peninsula. These recommendations also allowed some room to have lower sample size of collars on the Bluenose-West and Cape Bathurst caribou "without much risk of underestimating herd size." (Rettie 2008 *In prep.*). Despite their higher cost, SAT and GPS collars were deployed instead of VHF collars in order to gain the best quality data possible from collared animals. We deployed less than the ideal collar number for the Bluenose-West and Cape Bathurst due to financial limitations. We used targets of 60 collars for Bluenose-West, 25 for Cape Bathurst and 25 for Tuktoyaktuk Peninsula. This is close to a second set of recommendations made by Rettie (2008 *In prep.*) in which he used artificial herd simulations and considered marginal values associated with different numbers of collars to recommend 60 Bluenose-West, 30 Cape Bathurst and 30 Tuktoyaktuk Peninsula collars. The number of collars required in a herd to have a good probability of detecting herd size is influenced by the number and size of groups during aggregation in addition to the actual population size (Rettie 2008 *In prep.*). We did not reach our target number of collars for the Bluenose-West herd, due to mortalities and malfunction of some collars.

The Cape Bathurst and Bluenose-West incidental observation rates of 7.2% and 8.9% were similar to those reported by Nagy and Johnson in 2006 (9.0% and 8.6% for Cape Bathurst and Bluenose-West herds, respectively). Although the 2009 Tuktoyaktuk Peninsula incidental observation rate of 16.3% was higher than in 2006 when it was 6.4%, the observations of groups with multiple collars (eight collars in a Tuktoyaktuk Peninsula group, six collars in a Cape Bathurst group and 12 collars in a Bluenose-West group) suggest that all significant groups were found and photographed. See discussion below for Assumption 2.

Evaluation of Assumptions

Assumption 1: The population is closed.

Satellite tracking the SAT and GPS collars allowed for the monitoring of each herd. There was one Bluenose-East collared caribou in a group with a Bluenose-West collared caribou. Despite this one collar, the post calving season has less overlap than any other season. There is seasonal overlap between adjacent herds, especially in the winter (Nagy et al. 2005).

There is no significant adult mortality or movements between herds over the timeline of the photo survey as all collars are inventoried at the beginning and tracked throughout the survey. Therefore the closed population assumption is valid for the groups of caribou with collars identified by herd during the post calving season.

Assumption 2: All highly aggregated groups contain at least one radio collared caribou and thus can be located.

We are confident that all large aggregations of caribou on the post-calving ranges were located. There were two groups on the Bluenose-West post-calving range that had more than 100 caribou but no collars; these two groups were close to other groups with collars (Figure 4). There were only three groups on the Cape Bathurst post-calving range that did not have collars associated with them and of the three, the largest group size was only 66 adult caribou. Under ideal conditions the groups without collars would likely have joined the near-by groups. There were two groups from the Tuktoyaktuk Peninsula herd that were >100 caribou with no collars and these groups were located along the coast close to groups with collars.

The percentage of caribou accounted for by incidental observation was low for the Cape Bathurst and Bluenose-West herds. There was a higher percentage of caribou located incidentally for the Tuktoyaktuk Peninsula herd (Figure 3); however, these groups were close together.

It is possible that some groups were not located and counted. We assume the number of missed groups to be minimal. This assumption maybe not explicitly be met; however, it is not believed to have greatly affected the population estimate.

Assumption 3: Radio collared animals are randomly distributed throughout the herd.

Collars were distributed over the entire occupied late winter (March) distribution (Figures 1, 2). The time elapsed between collaring and post-calving allowed for some random mixing of the migrating caribou. We believe this assumption was met.

Assumption 4: No significant movement of individual caribou, among photographed groups used in the estimate, occurred during the photo-survey.

Photographs were taken within one day on the Tuktoyaktuk Peninsula. The majority of the Cape Bathurst herd was also photographed in a single day except for four small groups (total of 18 caribou) south of Husky Lakes (Figure 5) that were photographed on 13 July, the same day as the Tuktoyaktuk Peninsula groups were photographed. These were geographically separated from the main groups and were monitored using the SAT/GPS collars to ensure these groups were not counted twice. Photos were taken over two consecutive days for the Bluenose-West herd; however, the areas photographed were geographically distinct between these two days (Figure 4). We believe that this assumption was met as all collar frequencies were continually monitored to ensure that groups were not counted twice.

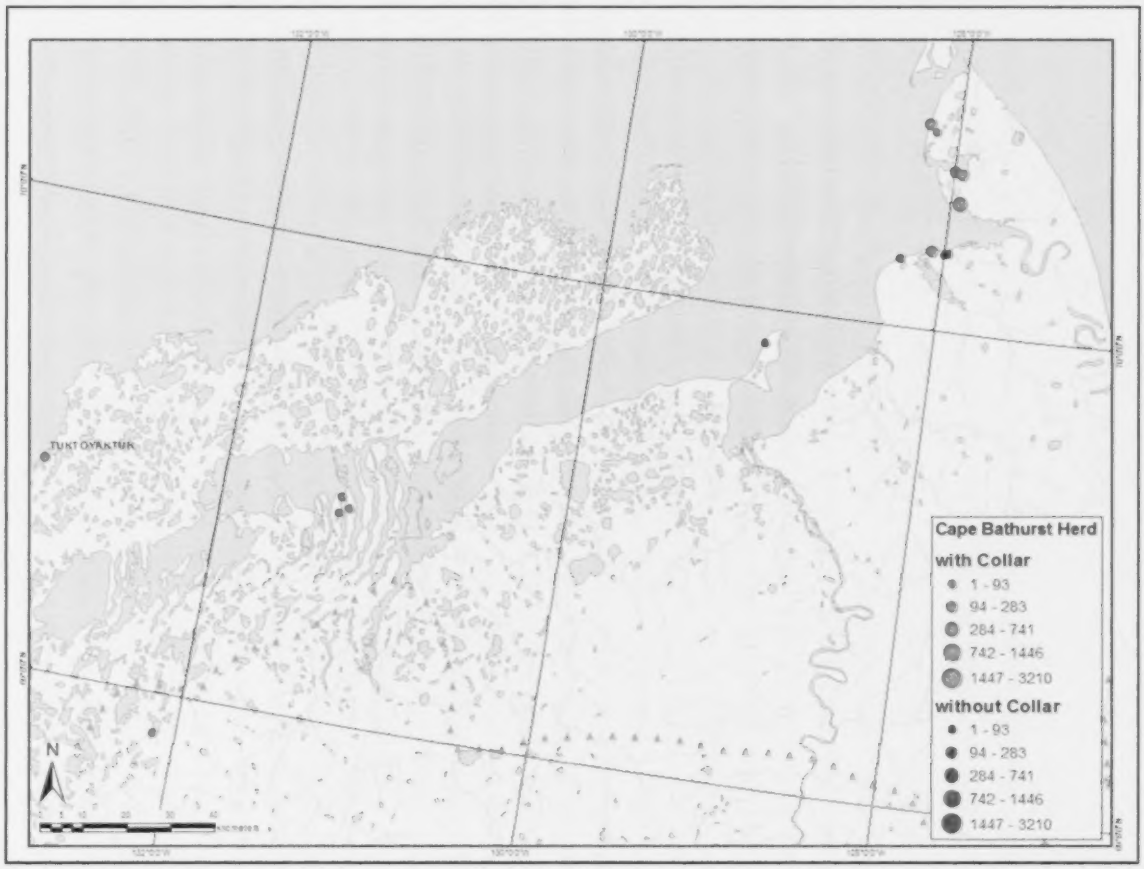

Figure 5: Locations of caribou groups observed on 13 and 18 July on Cape Bathurst herd's post-calving range.

Weather Conditions

Early July was cool along the coast, with snow falling on the post-calving range of the Bluenose-West herd on several days (7 July, 9 July and 14 July). However, warm temperatures and calm winds occurred on the survey days. Such weather conditions resulted in fewer groups and larger caribou aggregations.

Conclusion

The estimated population sizes of the Cape Bathurst and Bluenose-West herds appear to have stabilized since 2006 with the Tuktoyaktuk Peninsula herd declining

slightly. A contributing factor to the stabilization of the Cape Bathurst and Bluenose-West herds is likely the management actions implemented by the co-management boards.

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